developing from most of the soils is probably the mycelium of fleshy fungi. Other organisms, such as the *Penicillia, Fusaria* and *Sporotricha,* which are usually found in the soil abundantly when plated out by the dilution method, have been isolated by this method only in very few cases. The *Aspergilli, Alternaria, Cladosporia,* the great majority of the *Penicillia,* and other organisms commonly found in the soil, have not appeared on the plates in twenty-four hours, when the soil has been inoculated directly upon sterile medium.

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THE AMERICAN CHEMICAL SOCIETY. IV

DIVISION OF WATER, SEWAGE AND SANITATION

Edward Bartow, *Chairman*

H. P. Corson, *Secretary*

Sanitary Surveys as a Feature of Public Health Work: H. E. BARNARD.

Sanitary Survey Methods: J. C. DIGGS.

A Sanitary Survey of Logansport, Ind.: J. C. DIGGS.

Swimming Pool Sanitation: W. LEE LEWIS.

The Rate of Ammonia Distillation in Water: F. W. BRUCKMILLER.

A Modification of the Whipple Method for Direct Nesslerization: F. W. BRUCKMILLER.

The Determination of Carbonic Acid, Combined and Free, in Water: JOHN JOHNSTON.

The Numerical Treatment of B. coli Values in Water Analysis: EARLE B. PHELPS AND WILLIAM F. WELLS.

Development at Lawrence of the Process of Purifying Sewage by Aeration and Growths—Activated Sludge: H. W. CLARK.

This paper describes the discovery and development at the Lawrence Experiment Station of the Massachusetts State Department of Health of the method of purifying sewage by aeration and growths—a method known quite generally as the activated sludge method. The paper shows that the method was developed there in 1911 and 1912, was shown to Dr. Gilbert Fowler, of Manchester, Eng., in the fall of 1912 and that the English work was largely a repetition of the Lawrence work. It quotes from Fowler and from Ardern and Lockett, his colleagues, to prove that their activated sludge work was based upon the Lawrence work. The paper further gives the statement of Dr. McLean Wilson, of England, made in his presidential address to the Association of Sewage Works Managers. This statement is as follows:

> Many investigators, including Drown, Dupre and Dibdin, Mason and Hine, Black and Phelps, Fowler and others, had sought to purify sewage by direct chemical oxidation by means of air currents and had failed. At Lawrence, however, the efficiency of growths in the purification of sewage by aeration was discovered.

The paper further describes the Lawrence work during the past four years and the results of much of this work. These results show that sewage can be fairly completely purified by this method. The paper is concluded as follows:

> Finally, the governing factors in the success of this process of sewage treatment are, as I have stated in previous articles: (1) The cost of power for supplying the large volume of air necessary; (2) a sewage that readily yields itself to this method of treatment. It is not impossible to believe that certain sewages can not be purified in this manner.

Composition of the Effluent Air from an Activated Sludge Tank: F. N. CRAWFORD AND EDWARD BARTOW.

Experiments with Activated Sludge at Milwaukee, Wis.: W. D. COPELAND.

The Aeration of Sewage in the Presence of Activated Sludge from the Standpoint of an Engineer: E. J. FORT.

Activated Sludge Experiments at the Baltimore Sewage Disposal Plant: CALVIN W. HENDRICK.

Chemical Observations of the Activated Sludge Process as applied to Stock Yards Sewage: ARTHUR LEDERER.

The Activated Sludge Process: W. D. RICHARDSON.

The Sewage Experiment Station of the Illinois State Water Survey: J. F. SCHNELLBACH AND EDWARD BARTOW.

The Experiments with Activated Sludge at Brockton, Mass.: ROBERT SPURR WESTON.

Brockton, Mass., population 62,000, discharges an average of 2,100,000 gallons fine-screened sewage daily, two thirds on 30 acres of sand beds, one third on 0.5 acre trickling filter, followed by 7 acres of sand beds. Rates are low; efficiency also. Difficulty due to stale, strong sewage containing shoe factory waste and dyes. (Suspended solids 204, free ammonia 55.8, chlorine 138.6 p. p. m.) Plain aeration with and without contact followed by Imhoff tank and trickling filter treatment was tried in 1915 with unsatisfactory results. More aeration was required. Fill and draw activated sludge tank followed by sand bed at 500,000

gallon rate gave excellent results. Continuous process now being tried for clarification alone. Results good. Aeration period at least four hours. Complete nitrification never obtained by aeration even after 25 days. Nevertheless, activated sludge process alone offers relief to present overtaxed plant.

Some Results on the Treatment of Packing House Sewage by the Aeration Process in the Presence of Activated Sludge: PAUL RUDNICK AND G. L. NOBLE.

The Saving Effected by Using a Softened Water in Boilers: G. S. COTTER.

The Treatment of Industrial Wastes: HARRISON P. EDDY.

Some Studies on Chemical Self Purification in the Ohio River: EARLE B. PHELPS AND HAROLD W. STREETER.

Oxygen Demand Determination in the Field: F. W. BRUCKMILLER.

The Determination of Nitrates in Sewages by the Ortho-Toluidine Reagent: EARLE B. PHELPS AND H. L. SHOUB.

Studies on the Removal of Manganese from Water Supplies: H. P. CORSON AND EDWARD BARTOW.

The Value of Softened Water to a Railroad: R. C. BARDWELL.

Softened Water and Its Benefits in Laundry Work: JOHN H. RYAN.

Some Features of Swimming Tank Control: W. LEE LEWIS.

The American literature offers very little direct data on the epidemiology of swimming pools, though there is general expression to the effect that such pools may spread gastro-intestinal, respiratory and even venereal diseases if improperly controlled. The rotating or continuous filtration system maintains a more sanitary pool than intermittent filling. Both should be supplemented by daily sterilization. Pool water of Lake Michigan type, as shown mathematically and experimentally, should not be rotated under the conditions more than three months on account of decreasing alkalinity and increasing hardness.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Irving Langmuir, *Chairman*

James Kendall, *Secretary*

The Chromic-Chromous Potential at Mercury Electrodes: GEORGE SHANNON FORBES AND H. N. RICHTER. (Lantern.)

Pure violet $CrCl_3$, partially reduced to $CrCl_2$ by purified hydrogen at 400° in quartz, was dissolved with stirring in ice-cold, tenth normal hydrochloric acid. The solution, filtered into the cell, was allowed to stand over pure mercury. If all operations were conducted in hydrogen or carbon dioxide absolutely free from oxygen, the potential rose throughout two days to a constant maximum, otherwise it fluctuated irregularly. Concentrations at equilibrium were determined analytically. Referred to normal hydrogen electrode as zero, with correction for junction potentials,

$$\pi = -0.400 + 0.065 \log \mathrm{Cr^{III}}/\mathrm{Cr^{II}}.$$

On platinum potentials reached a maximum about 0.16 volt lower, with evolution of hydrogen.

Heterogeneous Equilibria between Aqueous and Metallic Solutions: A Study of Mixed Sodium and Potassium Salt Solutions at Total Concentrations varying from 0.2 N to 4.0 N: G. MCPHAIL SMITH AND T. R. BALL. (Lantern.)

The Contamination of Precipitates in Gravimetric Analysis: Solid Solution and Adsorption vs. Higher-Order Compounds: G. MCPHAIL SMITH.

An Electrically Controlled Calorimeter for Measuring Heats of Dilution: D. A. MACINNES AND J. M. BRAHAM. (Lantern.)

On the Evolution of the Elements according to the Hydrogen-Helium System: W. D. HARKINS. (Lantern.)

Theoretical Relations of the Atomic Weights: W. D. HARKINS. (Lantern.)

A New Gravimetric Method of Determining Aluminum, and of Separating that Metal from Zinc, Manganese, Nickel, Cobalt, Iron and Chromium: LOUIS KAHLENBERG AND K. P. YOUNG.

When ammonium salicylate is added to a dilute solution of an aluminum salt, and this solution is then boiled, there separates out in granular form a basic aluminum salicylate of the composition $(Al(C_6H_4 \cdot OH \cdot COO)_3)_3 \cdot Al(OH)_3$. This may be readily filtered off, washed with hot water, ignited and weighed as Al_2O_3. The precipitate is much more readily handled than the usual slimy and gelatinous precipitate of aluminum hydroxide. Zinc, manganese, nickel, cobalt, ferrous iron and chromium are not thus precipitated by ammonium salicylate, which fact is the basis for the direct and simple separation of these metals from aluminum. The solution should be fairly dilute, lest the basic aluminum salicylate occlude notable amounts of the other metals. If this should occur, redissolving the precipitate and then reprecipitating from the dilute solution will secure a good separation. Sodium salicylate may be used as the

precipitant instead of ammonium salicylate, but the latter is preferable.

The Electromotive Forces of Concentration Cells and their Relation to the Transference Number: D. A. MacInnes.

The Complete Solubility Curve of Calcium Carbonate: John Johnston.

The Specific Conductivity of Pure Water in Equilibrium with Atmospheric Carbon Dioxide: James Kendall.

An Apparatus for Determining Freezing-Point Lowering: R. G. Van Name and W. G. Brown.

The Colloidal Phosphates and Arsenates of Iron: Harry N. Holmes.

The Formation of Crystals in Gels: Harry N. Holmes.

The Potential of Iodine Concentration Cells: Grinnell Jones.

A Supposed Effect of the Form of Container upon the Density of a Gas: William A. Noyes and Laurence C. Johnson.

In an effort to explain the difference in the volumetric ratio of hydrogen to oxygen in water as determined by Morley and by Scott, the volume occupied by a gas in a system of tubes has been compared with that occupied by the same mass of gas in a bulb. It has been shown that there is no difference in volume larger than one part in ten thousand, whereas the two determinations referred to differ by one part in one thousand.

A Demonstration of the Selective "Action" of Clay on Soluble Sulphides: John C. Ingram.

The Theory and Mechanism of Adsorption: Irving Langmuir.

The Oxides of Iron. II. Magnetic Properties of the System Fe_2O_3-Fe_3O_4: R. B. Sosman and J. C. Hostetter.

The Dissociation of Ferric Oxide in Air: J. C. Hostetter and R. B. Sosman.

On the Measurement of the True and Apparent Electrical Conductivities of Solutions: Inductance, Capacity, Frequency and Resistance Relations: H. P. Hastings, W. A. Taylor and S. F. Acree.

Separation of the Elements of the Tin Group: J. M. Welch and H. C. P. Weber.

A very characteristic combination of tin and antimony sulfide, which is always formed when tin and antimony are precipitated together, is utilized as an indication of the presence of these two elements. The compound formed, which is probably a salt of thioantimonic acid, has not been isolated as yet, but a few compounds of the type are known. The reaction is characteristic for all mixtures of tin and antimony lying between 1:20 and 20:1.

The procedure consists in obtaining this brown-black color reaction, redissolving the sulfides without separation, precipitating the antimony as sulfide from an oxalate solution and reducing the stannic chloride in the filtrate to stannous chloride with metallic lead.

The process described is shorter and its use by students has resulted in a material decrease in the number of errors (as shown by statistics) in the work done.

Differential Iodimetry. III. Determination of Vanadium in the Presence of Iron and Uranium: O. L. Barnebey.

Differential Iodimetry. II. Determination of Chromium in the Presence of Iron: O. L. Barnebey.

Precipitation of Magnesium Ammonium Orthophosphate: Edward G. Mahin.

Some Laboratory Experiments on the Extraction of Radium from Carnotite Ores: A. G. Loomis and Herman Schlundt.

A System for Reports on Quantitative Analysis to be used in Teaching: E. Gill.

The Action of Anhydrous Aluminium Chloride upon Unsaturated Hydrocarbons: W. E. Henderson and W. C. Gangloff.

The Determination of Solubility Curves by the Method of Flotation: W. E. Henderson and Gebhart Stegeman.

Determination of Transition Points by the Measurement of Electromotive Force: W. E. Henderson and I. W. Geiger.

A Systematic Procedure for the Separation of the Anions: First Group: H. A. Winckelmann and H. C. P. Weber.

The problem of the systematic separation of acids, which has received very little attention in analytical methods, is an especially important one in connection with instruction in chemistry, and possibly of more importance generally than is realized. Actually, very little has been done in the subject.

By means of the plan outlined mixtures containing any or all of the radicals, ferrocyanide, ferricyanide, cyanide, thiocyanate, chloride, bromide, iodide, sulfide, in quantities varying from 0 to 100 mg. may be satisfactorily analyzed, and their amounts estimated. The steps can not well be presented in abstract, but the manipulations are the customary ones of qualitative analysis, the

successive reagents being zinc salts, silver salts, mercuric salts, alkaline formates, metallic copper and cuprous salts.

On Some Molecular Compounds in Glass: E. W. TILLOTSON.

On the Variable Rotatory Power of Dissolved Organic Substances: M. A. ROSANOFF AND H. A. MORTON.

On the Constant a of Van der Waal's Equation: M. A. ROSANOFF AND H. C. CORLISS.

On the Change of Transition Points with Pressure: M. A. ROSANOFF.

A Rational Process of Fractional Distillation: M. A. ROSANOFF.

A Study of Some of the Physical Properties of Mixtures of Dielectric Oils and Water. (Preliminary Report.): L. I. SHAW AND L. A. PAPPENHAGEN.

Change of Conductivity with Time in the System $MeOH + I_2$. (Preliminary Report.): L. I. SHAW AND J. P. TRICKEY.

Atomic Weight of Yttrium: C. W. BALKE AND B. S. HOPKINS.

The Potassium Iodide Reaction for Platinum: W. J. PRINCE AND H. C. P. WEBER.

The cherry-red, to rose, tint which is produced in platinum solutions by means of potassium iodide is one of the most sensitive tests known. Apparently well-suited for the purpose of colorimetric estimation of the quantity of platinum in solutions, the reaction has not been used for this purpose for lack of ability to properly control conditions.

This investigation shows that the resulting color is not the result of the formation of a reduction product, such as a platinous compound or of colloidal platinum. There is an intermediate formation of a complex iodide, and the water plays an essential part (hydrolysis) in the reaction since the color is not developed in certain other solvents. Immediately after development of maximum color intensity has been attained a colloidal phase can be distinguished in the ultramicroscope, but this is platinum iodide. The rate of the reaction is affected enormously by the quantity of KI present. If only theoretical proportions of this substance are added (6KI: 1 Pt) the reaction goes almost directly to black colloidal PtI_4. The reaction curves show that 4 to 5 times the theoretical quantities of KI are necessary to produce satisfactory results. As little as 2×10^{-7}g. Pt may be recognized in 1 c.c. of solution.

From consideration of the optimum conditions necessary for the production of the desired color reaction it is hoped that a colorimetric method for the estimation of Pt may be developed.

The Viscosity of Alcoholic Solutions: O. F. TOWER.

The Relation between Molecular Cohesion and Surface Tension. Eötvös Law: ALBERT P. MATHEWS.

Determination of Aluminium as Oxide: WILLIAM BLUM.

The various factors affecting the precipitation, washing and ignition of aluminium hydroxide in quantitative analysis were studied. By means of the hydrogen electrode it was found that the precipitation is complete at a point between the turning points of the indicators methyl red and rosolic acid, the use of which is therefore recommended. The conditions for the accurate estimation of aluminium are defined.

A Study of Tantalum Pentachloride for Atomic Weight Purposes: G. W. SEARS AND C. W. BALKE.

A Study of the Dialysis of a Colloidal Solution of Hydrous Chromic Oxide in Chromium Chloride: MARKS NEIDLE AND J. BARAB.

The Temperature Effect in Dialysis, and a Simple Rapid Dialyzer: MARKS NEIDLE.

Production of Triatomic Hydrogen by Radium Rays: G. L. WENDT.

The Effect of Dissolved Substances on the Velocity of Crystallization of Water: J. H. WALTON AND A. BRAUN. (Lantern.)

The Atomic Weight of Dysprosium: C. W. BALKE AND E. W. ENGLE.

Dysprosium material was purified by the alkali sulfate separation, followed by fractional crystallization of the bromates, ethylsulfates and nitrates. For the atomic weight determinations the oxide-chloride ratio was studied. Dysprosium oxide, Dy_2O_3, was placed in a tarred quartz flask, weighed, dissolved in HCl, and the chloride dehydrated, fused and weighed in the flask. Five consecutive determinations gave the values 164.354, 164.357, 164.116, 164.104, 164.207. Mean value 164.228. This is considerably higher than the value now in the International Table.

Potassium Lead Tartrate: R. S. DEAN.

The Density of Aqueous Copper Sulphate-Sulphuric Acid Solutions: H. D. HOLLER AND E. L. PEFFER.

The densities of solutions of copper sulphate and sulphuric acid varying in concentration from 0 to 20 per cent. of each solute, were determined at 25° and 40° C. The densities were found to be approximately additive, and to be dependent upon the total concentration of the two solutes.

An Electrical Insulating Material for Use in Moist Atmospheres: EDWARD W. WASHBURN.

Types of Wheatstone Bridges for Alternating Current Work: EDWARD W. WASHBURN.

Induced Reactions in the Analytical Chemistry of Lead: V. H. GOTTSCHALK.

An Attempt to Combine Nitrogen and Chlorine Directly: B. R. HONOVSKI, L. C. JOHNSON, F. O. ANDEREGG AND W. A. NOYES.

Pure nitrogen and chlorine are sparked in a glass apparatus, using gold tipped electrodes. Results vary from 0.2 mg. to 1.5 mg. of combined nitrogen on Nesslerizing. These values were checked by blank analyses at all times.

The Nernst Integration Constant in Gaseous Systems: N. HOWELL FURMAN.

Attention is called to the fact that owing to the lack of sufficient data concerning the specific heats of solids over wide range of temperature, and the absence of such data in the case of liquids, the rational vapor pressure formula,

$$lu\pi = -\frac{\lambda_0}{RT} + \int \frac{1}{RT^2}\, dT \int [\epsilon_p - c]dT + i,$$

can rarely be applied to the interpretation of vapor pressure measurements.

The Nernst approximation formula,

$$\log \pi = \frac{\lambda_0}{4.571T} + 1.75 \log T - \frac{\epsilon}{4.571}\, T + c,$$

is more generally applicable, but care must be exercised in its employment, otherwise the values deduced for the several constants will not possess any physical significance whatever.

These points were illustrated by numerical calculations.

The Reactivity of Acids: HUGH S. TAYLOR.

The Specific Heat and Specific Kinetic Energy of Elements and Compounds: J. E. SIEBEL.

After devising formulæ for the specific molecular kinetic energy increase, the author determines this and corollary quantities for representatives of different groups of gases and vapors. The tabulated results demonstrate the constancy of their molecular kinetic energy against the inconstancy of their molecular heat (Dulong and Petit product); they also yield the molecular velocity in harmony with Millikan's number of molecules, the relation of molecular velocity to sound propagation, the equivalent of volume- and kinetic-energy, etc. Accordingly these quantities appear as functions of the rectilinear, progressive motion of the molecules not dependent, that is not directly so, on other intermolecular-latent-disgregation- or rotary-energy.

Vapor Pressures of Ethyl Alcohol and Alcoholic Water Mixtures at 25° and Composition of Vapors in Equilibrium with the Mixtures: I. H. DERBY AND F. DANIELS.

Composition Dissociation in Concentrated Solutions of Sodium Chloride and Potassium Chloride: I. H. DERBY, D. MAYARD AND E. T. FEGON.

The Dissociation Pressures of Various Salt Hydrates and the Vapor Pressures of their Saturated Solutions: I. H. DERBY AND V. YNGVE.

The Swelling of Rubber in Various Liquids and the Nature of the Process: I. H. DERBY, P. D. SCHULTZ AND O. D. CUNNINGHAM.

A Study of 0.1 Normal HCl Calomel Electrodes: N. E. LOOMIS.

DIVISION OF PHARMACEUTICAL CHEMISTRY

John H. Long, *Chairman*

Geo. D. Beal, *Secretary*

The New Features of the U. S. P. IX.: JOSEPH P. REMINGTON. (Lantern.)

The Toxicity of the Volatile Principles of Coffee, with Comments on Coffee Substitutes: L. E. SAYRE.

The Pancreatin Tests of the Pharmacopœia: J. H. LONG.

Rennett: A Note and a Correction: HOWARD T. GRABER.

Pepsin: A Résumé of Tests: HOWARD T. GRABER.

Relative Toxicity of Different Species of Digitalis: ROBERT A. HALL, E. L. NEWCOMB AND R. E. MORRIS.

On the Apparent and Real Ash Content of Digitalis: NORBERT MUELLER AND EDWARD KREMERS.

Alkaloidal Assay by Immiscible Solvents: H. F. LEWIS AND G. D. BEAL.

The Preparation and Characteristics of Emetine: FRANK O. TAYLOR.

Some Unexpected Reactions in Pharmaceutical Mixtures: FRANK O. TAYLOR.

The Strength of Fluid Extracts: H. A. LANGENHAN AND EDWARD KREMERS.

On Tincture of Peppermint for Coloring Purposes: NORBERT MUELLER AND EDWARD KREMERS.

Further Notes on the Identification of the Emodin-containing Drugs: RUTH E. OKEY AND G. D. BEAL.

Determination of Small Amounts of Water and Alcohol in Ether for Anesthesia: E. MALLINCKRODT, JR.

The Detection of Minute Quantities of Unsaturated Hydrocarbons in Liquid Petrolatum: C. H. BRIGGS AND W. L. IRWIN.

CHARLES L. PARSONS,
Secretary